

# SUPPLEMENT.

## The Mining Journal, RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

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### Original Correspondence.

#### BIRMINGHAM, AND THE BLACK COUNTRY—No. I.

It is our purpose, under the above heading, to lay before our readers a series of articles upon the industries relating to iron and other metals as carried on in Birmingham, and the iron and coal districts of South Staffordshire and East Worcestershire. We shall endeavour to give a brief history of each separate trade, a full description of the principal works, and any interesting facts we may glean in connection therewith. In the title chosen we give priority to Birmingham, as it is a town of such vast importance, and the great trading centre of England; yet as it derives a considerable amount of the material used in its manufactures from the Black Country, we shall first have to deal with the resources and works of the latter. We might almost say that Birmingham has risen out of, and is to a great degree dependent upon, the Black Country. The object we have in view is not only to furnish interesting matter which will make our readers acquainted with this extensive and important hive of industry, and thus afford them a passing gratification, but we wish also to make these articles a sort of record of the various trades as they stand at the present time. The want of some such account has often been felt, for it is surprising how little is known, or can be discovered, in reference to most of the staple trades of this country; we shall, therefore, find great difficulty in compiling even a brief history of each, but shall be able to give full particulars of them as they now are, and thus these articles may be of some service and aid to those who may institute researches in the distant future. We also hope in the course of these articles to throw out some suggestions which will, if put into practice, tend to the advancement of the iron and other trades of the Black Country. Our ambition does not lead us to suppose that we could give advice that would improve many of the leading Birmingham trades, as they are being more and more perfected daily, and employ all attainable means that are likely to promote success. As regards the iron trade of South Staffordshire, there is great room for improvement, for this district, after having been the nursery of the iron trade, and having reared it to anything like a state approaching perfection, is left behind by those which are of a modern growth, and are able successfully to compete with it.

We are aware that the position of South Staffordshire, being at a distance from any seaport, and consequently having to pay heavy freights, is a great disadvantage, but not sufficiently so to account for their being so far behindhand; the great secret is the ridiculous conservatism of the ironmasters, and their objection to adopt new ideas. With some few exceptions the ironworks of Staffordshire are little altered from what they were 20 or 30 years ago. Can it, then, be expected that the ironmasters of such works can compete with those who have started where they left off, and who have adopted all the latest improvements? That Staffordshire could yet be successful, and attain the lead, is an established fact, for some of the leading firms, let the times be good or bad, are almost constantly in full work, some of them demanding above the list price for their iron. The reason of this is they have gained a reputation for the good quality of their iron. We say, then, let South Staffordshire, now it is found the cannot successfully compete with other districts in inferior classes of iron, strike out a definite course, in the shape of good quality, for it is well known that Staffordshire iron cannot be surpassed when properly made. No place could have richer resources—there is the excellent ironstone, the limestone, and the famous pure thick coal, all found in the district.

The manufactures we shall notice will be, firstly, iron, wrought and cast, connecting therewith collieries and mines; and then others in the Black Country depending upon iron, such as engines and machinery, railway rolling stock, boiler, bridge, and gasometer workings, anvils and vices, wrought-iron tubes, hand-made nails, edge-tools, chains, cables, and anchors, fire-irons, locks, and cast-iron hollow ware. Of the Birmingham manufactures we shall take guns, heavy steel toys, brass tube, and other work, nuts and bolts, wire, and many others. Commencing with iron, we shall give a brief history of its manufacture. It would, perhaps, be thought more politic to have dealt first with the products—ironstone, limestone, and coal—from which iron is made; but as iron was made long before coal was discovered, or, at least, the use of it, and before mining for iron ore to any extent had to be resorted to, we shall leave this part of the subject for another article, and deal now with the history of iron.

That the ancients were conversant with the use of iron is quite clear, from discoveries that have been made. The Greeks and the Egyptians are supposed to have had articles manufactured from iron in common use long before the birth of Christ; and the specimens discovered by Mr. Layard in his excavations at Nineveh, now in the British Museum, establishes the fact that the Assyrians were makers to some extent of iron implements.

That the Britons, previous to the invasion of Caesar, were acquainted with iron is not an established fact, although Mr. Lower, the famous antiquarian and archaeologist, takes it as such, when he states that the formidable scythes attached to the axes of their chariots sufficiently prove it, to say nothing of the chariots themselves, which obviously were not made without the use of iron. The Romans extracted iron from the ore, to a great extent, in the Forest of Dean and the Weald of Sussex, where large quantities of ancient iron slags are found, containing Roman coins, fragments of Roman pottery, &c.

Little or no progress seems to have been made from the time we mention till about the sixteenth century. The primitive mode of extracting the metal from the ore was carried out in a small rough furnace, to which was connected a bellows, made from the skin of some animal. The ore, which was of necessity rich, was embedded in small quantities in a charcoal fire made in the furnace, and after being subjected to a moderate amount of heat for a few hours was so reduced that it could be drawn out while red-hot into a bar. Iron is manufactured in this way in Central Africa and India at the present time. It was not till the sixteenth century, as far as it has yet been ascertained, that iron was fused and cast; but at this time it must have been carried on to some considerable extent, for we find that two Acts were passed in the reign of Elizabeth prohibiting the erection of works for making iron in certain counties, and also forbidding persons to fell timber to be converted into charcoal for ironworks purposes. Great fear was then entertained that the supply of

timber would be exhausted, so that there would not remain a sufficient quantity, of the requisite quality, wherewith to build the ships. The great reformation was the substitution of pit coal for charcoal in the manufacture of iron, and this was attempted by Simon Sturtevant and also John Rovenzon, in the reign of James I., at the commencement of the seventeenth century, but was never fully accomplished until taken up by Dud Dudley. Sturtevant took out a patent for extracting iron from the ores, but having been outlawed, and failing to act up to the provisions of the patent, it was cancelled. Rovenzon at this time took it up, and to him is attributed the invention of the reverberatory furnace, for in a little work published by him, entitled "A Treatise of Metallia," he sets for the principles of such furnace. He states that the material to be wrought was kept apart from the fuel, and that the furnaces were wind ones, and dispensed with bellows and the mill for blowing them. He also states that by adopting his furnace and using coal as a fuel an ironworks could be started with an extremely small capital, as compared with that required for the old process.

There is no proof that Rovenzon successfully worked his process, while it is quite certain that Dud Dudley smelted iron with coal. Dud Dudley, of Tipton, near Dudley, was one of the family of whom the Earl of Dudley is now the representative, and who still keeps the prestige of the family by making the best iron in the world, very near the same spot chosen by Dud Dudley for his experiments. This latter personage commenced trials in 1619, at his father's ironworks, situated at Pensnett, near Dudley; he converted a furnace in which iron was smelted by charcoal, so that pit coal could be used: the yield at first was 3 tons per week. Being so far successful, he obtained a patent for his process, and carried on his manufacture for some time, amidst great persecution from the charcoal ironmasters, whom he was able to undersell, his price being 4l. per ton for pig-iron, and 12l. per ton for wrought bar-iron; whilst theirs was 6l. and 7l. per ton for pig-iron, and from 15l. to 18l. per ton for bar-iron.

Dudley erected blast-furnaces at Himley and Askew Bridge (both on the outskirts of Dudley), and at Bristol. His life was far from being tranquil, as he was several times deprived of his patent right, although succeeding to obtain it again; it was eventually refused him by Charles II., and he then ceased from pushing the matter further. Patents for the same purpose were granted to several persons in the time of Cromwell, but none of them accomplished the required object. A full account of Dud Dudley's labours will be found in his "Metallum Martis; and with the same Fuell to Melt and Fine Imperfect Mettals, and Refine Perfect Mettals." London: 1665. This little work was reprinted, by subscription, about 15 years ago, and copies can now be obtained. After the death of Dudley the secret of smelting iron with pit coal seems to have been entirely lost, and it was left to Abraham Darby to arrive at complete success, and this he did about the year 1735, at Colebrook Dale Ironworks, Shropshire.

The idea of using coal, which was plentiful in the neighbourhood of the works, seemed to have occurred to him, on account of the scarcity of charcoal, and he tried to use the two mixed, but with no good result. He then subjected the coal to the same treatment as wood required to be made into charcoal, and the product was coke. This latter substance he tried in his blast-furnace, and it is said he watched the result from the furnace top for six days and nights, and after many disappointments he was rewarded for his labours by seeing the molten iron issue from the furnace. From this time the manufacture of iron has progressed with rapid strides until attaining its present position. The introduction of the many improvements in machinery, &c., we shall have to notice at intervals during the course of these articles.

#### IRONWORKS AND COLLIERIES IN DERRYSHIRE. THE BUTTERLEY WORKS.

The largest works in connection with the iron and coal industries of Derbyshire, and which are, perhaps, the most complete in England, are those of the Butterley Company, situated on the Erewash Valley line of the Midland Company, about 14 miles from Chesterfield and 19 miles from Nottingham. The Butterley Company, which really consists of only two persons, Messrs. Wright and Jessop, not only as iron manufacturers, but also as colliery owners, are amongst the largest in the kingdom. The ironworks are so extensive and varied that every description of material required, from pig and puddled bars to the most complicated machinery, stationary or locomotive, are produced at them. Everything necessary for the raising of ore, coal, limestone, and other materials, to the finishing of the iron, is obtained from the resources of the company, who are not dependent upon others for anything they require. The ironworks are in two parts—the mills, puddling-furnaces, and wagon-sheds at Codnor Park, and the engine and other branches of a similar character at Butterley, distant from the former between two or three miles. At the two places there are eight blast-furnaces, four at each place. At present there are but five in blast, two at Codnor Park, where a large new one is all but completed, and three at Butterley. The furnaces are of about an average height, the blast being heated in the ordinary way. There are between 40 and 50 puddling-furnaces of the general type, and which are kept steadily going. The output of pig, as might be expected, is the largest in the country, whilst from the character of the material manufactured the requirements of the raw material for the supply of the works are very large indeed.

There are a large number of mills kept constantly going, the firm doing a very large trade in rolled material. There are two plate-mills, a beam-mill (patented by Sir John Alleyne, the general manager of the works), two merchant-mills, comprising a 24-inch and a 21-inch train, with a guide and sheet mill. The Butterley Company are especially known as the largest girder makers we have, and appear to have absorbed the largest portion of that important branch of iron manufacture, not only in England but also on the Continent. During the last two or three years some girders of a rather extraordinary character were produced at the works: foremost amongst them may be mentioned those now to be seen at the St. Pancras Station, and which for extent, we believe, are about the largest that can be seen anywhere, and are in every way splendid specimens of that description of work. Similar work is now being executed for a very large bridge for the Dutch Government, and which promises to be a model one, and well calculated to enhance the reputation of our English manufacturers. At the works there are also produced locomotive and other engines, axles, tyres, some few rails, sheets, plates,

wagons, corfs, and every description of castings, and, in fact, every description of iron goods. The engines and boilers are of the best description, and the works are replete with every necessary convenience for the economical working of such a vast concern. For the conveyance of the material to and from the works there are several locomotive engines, with a very large number of wagons, for the manufacture of which there is a large shed, from which there is a line of rails on the Erewash Valley Railway of the Midland system.

In connection with the works there are the usual sheds, including an extensive foundry, where every description of heavy and light castings are produced, with blacksmiths' and joiners' shops. There are also steam-hammers, shears, and all the usual gearing in connection with the production of pig and manufactured iron. Close to the railway, but on the other side of the works at Codnor Park, the slag is broken by a machine driven by a small engine. When broken the stone is raised in small square boxes by means of a flexible iron ladder some 14 or 15 feet, and is then tilted over a screen into the wagons, by which means all the dust and very small stone is kept separate for that adapted for road-making purposes.

The collieries of the Butterley Company are numerous, and from which an immense quantity of coal of very good quality is raised. It may be said that the seams of coal worked in Derbyshire consist principally of the black shale, or Silkestone, the lowest beds, and which commences near to Alfreton, where it is known as the "clod coal," owing to its being found in connection with fire-clay; and then proceeds northward into Yorkshire. The other seam, which is most generally worked, is that known as the "Upper Hard," but in Yorkshire known as the Barnsley thick coal, and which varies very much in quality and thickness. Between the two seams are some valuable deposits of ironstone, in some instances unequalled by any clayband ore in the kingdom. The quantity of coal raised by the company is very large indeed, as they are owners of the Codnor Park Colliery, from which last year there was sent to London alone 96,714 tons. In the same district, that of Alfreton, they have also Brand's soft coal pits and the Butterley Park, Forty Horse, Hartshay, Langley, Loscoe, Newlands, New Main, Ripley, and Upper Birchwood Collieries. In the Ripley district they have the Marehay, Whiteley, and Water Gates Collieries, and the Granby Colliery, near Ilkeston. Those collieries raise some hundreds of thousands of tons annually, so that, in addition to supplying the large requirements of the ironworks at Codnor Park and Butterley, extensive consignments are forwarded to the London and other markets. There are also several mines from which ore is raised, so that, with some little exception, all the ironstone required is raised from the pits belonging to the firm. It is of an argillaceous character, and produces a very good quality of iron. Another essential for the production of iron in its crude state—limestone—is also worked by the Butterley Company, and, with the coke made, leaves nothing whatever to be supplied from other sources.

Something like 8000 hands are employed by Messrs. Wright and Jessop, and in justice to those gentlemen it may be stated that all has been done, and no expense spared, in promoting, in the most substantial and attractive form, the moral and social condition of the workmen and their families. They have built a large village—a model miniature town, in fact—known as Ironville, which has a population of something like 1500. There are excellent schools for the young, and a church, which is very well attended. There is also a very handsome building, known as the Ironville Institute, erected at a cost of some thousands of pounds, and which is well fitted up for social and other gatherings. It has a large hall for lectures, in which concerts are frequently given, with a well appointed library, and reading-room. In connection with the Institute there are commodious baths and washhouses, whilst tea, coffee, and other refreshments are to be had within the building, for which there is a considerable demand. Such has been the beneficial results of thus providing healthy and attractive food for the mind, as well as refreshment for the body, that we were informed by one of the managers that nearly 100 of the ironworkers were genuine teetotallers, in a great measure owing to an attraction equal to that of the publichouse being provided for them. The whole of the works, which are well laid out, are well worth visiting, seeing, as before stated, that almost every description of manufactured material in iron and machinery is produced within them complete.

#### COLLIERY WORKINGS IN DURHAM—No. III.

USWORTH COLLIERY, situated near Washington Station, on the North-Eastern Railway, has been in operation about 24 years. Messrs. Elliot and Johnassohn are the lessees of the colliery. It is conducted under the viewership of Mr. S. B. Coxon. Two pits were originally sunk to the Hutton seam, 200 yards in depth. These are 10 yards apart; the downcast, 12 ft. in diameter, is also the coal pit; the other pit, 10 ft. in diameter, is at present used exclusively as an upcast for the furnaces at the bottom of it. But it has become necessary to provide some additional means of ventilation, owing to the limited size of the upcast, and the large area of workings now laid out at considerable distances from the pits, in the Maudlin, Low Main, and Hutton seams. To accomplish this a new pit, 12 ft. in diameter, has recently been sunk, about 60 yards distant from the old pits, to be used only as an air-pit, and near to which is erected a Guibal fan, having communication to the pit through a spacious arched passage. The main feature of the new mode of ventilation is the great power of the fan, being the largest yet constructed. Several of these fans are in operation in the Durham coal field at pits of slight depth; but this is the first that has been erected for a deep mine, and at the same time an extensive range of workings. The fan is 45 ft. in diameter, and 12 ft. in width. The two driving-engines are placed diagonally, though nearly in a horizontal position, working direct to the shaft of the fan. Each cylinder is 36 in. in diameter, 3-ft. stroke, and has a piston-valve to be worked expansively by slot-link. The fan and engines were made at the works of Black, Hawthorn, and Co., Gateshead. The fan will be started in the course of two or three weeks, and it is calculated that 250,000 cubic feet of air per minute will be realised from it, when making 40 revolutions per minute.

The coal measures in this district throw off as much fire-damp as any part of the Durham coal field, and to conduct the mines with safety large volumes of air are required; the greatest care is imperative in its distribution, and in every operation in detail connected with the ventilation. The Maudlin and Hutton seams are worked.

altogether on the bord and pillar system, which is the old-established practice of mining in the district. The Low Main seam, however, is worked on the long wall system, with goaf-roads and extensive faces of work, this seam being peculiarly adapted to the system, and from which good results in produce of large coal are obtained. About 800 lamps are used in the mines, these being the Davy and Hann's patent lamps; no candles are permitted in the workings. Gunpowder is used for blasting the coal to a great extent, but the firing of shots is only permitted to be done by deputies, or persons specially appointed for this purpose. It may be mentioned here that "the Villepigne perforator" has been lately introduced at Usworth Colliery with great success. Three of them are now in use underground for boring in stone, and they are intended to be used generally for boring in coal. The machine bores in shale and in hard coal a 2-in. hole at the rate of 12 in. per minute.

The downcast pit is divided into two equal parts, by wood brattice, forming two separate coal shafts—the west pit and the east pit. The west pit winding-engine has one 48-in. horizontal cylinder, 6-ft. stroke, direct-acting, non-condensing, 38 lbs. steam-pressure. The engine is fitted with four piston-valves, worked by bevel wheels and cams, and the open-gearing common to the district, instead of slot links. Two flat wire-rope drums, 20 ft. in diameter at the first lift. Five plain cylindrical boilers, 50 ft. by 6 ft., supply this engine; four of them are in use; these are fed by a 4-in. donkey-engine. Each boiler is suspended from four cast-iron arched girders. This engine raises about 650 tons of coal per day from the Low Main level, 170 fms. in depth, with four-decked cages, each of which carries four 9-cwt. tubs. The cages are nearly altogether formed of steel. The east pit winding-engine is of the lever construction, with 36½-in. cylinder, 6-ft. stroke, 38 lbs. steam-pressure, double-beat valves, and the usual open hand-gear, as adopted in the district. Two flat wire-rope drums, 19 ft. in diameter. It raises 550 tons of coal per day from the Hutton seam level, or 200 fms., with three-decked steel cages; each cage carries three 9-cwt. tubs. In the west pit there are two hauling-engines placed underground. That for the north-east plane is placed 40 yards north from the pit bottom; it is a portable engine, without wheels, by Clayton and Shuttleworth, with two 10½-in. cylinders, 14-in. stroke, two cog-wheels in ratio of 1 to 3. The boiler has 40 tubes, steam-pressure 60 lbs. The engine is placed by the side of the plane, and the drums over it. There are two drums, 4 ft. in diameter, 3 ft. in width, on one shaft, put in or out of gear by a clutch. The north-east plane for 1000 yards is principally on a level, and for this both tail and main ropes are used to haul in and out; for a further distance of 800 yards the road dips to north-east, and the main rope only is used for this portion.

The Maudlin seam is supplied at this extremity, and the Low Main coal at the intermediate point, where the return sheave is fixed. The main-rope is 2½-in. steel wire, the tail-rope 2-in. steel wire; 50 tubs are run with each journey. The laden tubs run by gravity from the bank-head to the shaft, and the empty tubs run in the contrary direction. For the south-west plane the engine is placed about 80 yards from the pit bottom, in line with the road in-bye, but it curves back to the shaft. The engine has two 12-in. horizontal cylinders, 2-ft. stroke, slot-link motion, three wheels, in ratio of 1 to 4; two drums on separate shafts, 6 ft. in diameter, 2 ft. in width, one drum in front of the other, on the same level; the drums are put in or out of gear by sliding both carriages with crabs attached to the engine. The boiler is placed near the engine, and contains 42 tubes; steam pressure, 60 lbs. The engine and boiler are from Messrs. Black, Hawthorn, and Co.'s manufactory. This engine works 20 tubs for a distance of 150 yards in-bye, and also back to the shaft, both in and out, with the main-rope only. The sheave placed near the engine is on a hill, and from that the road dips both in-bye and to the shaft. When the tubs are brought out-bye to this point the rope is taken from the front of the train, passed over the sheave, and attached to the back of the train, without stopping it, by which it is let down to the shaft. Beyond the 150 yards length of dip a further length of 1600 yards, on an irregular gradient, is worked in and out by tail and main ropes: 60 tubs are run with each train on this portion. Beyond this, again, there is an inclined bank, which is worked by a loose rope, whilst the engine works the dips near the shaft. The ropes are all made from steel wire.

The cleavage in all the seams runs nearly north or south, and the principal workings are driven at right angles to this. The dip of the measures varies from 3 to 5 inches per yard; owing to this and the occurrence of faults, the produce from all three seams is usually brought out by one engine plane carried through the low main seam, and connected with the Maudlin and Hutton seams, by rise drifts to the former, serving as self-acting inclines; and by dip drifts to the latter, serving as roads for the application of engine power and the rope system. The whole of the main roads are thus made applicable for engine power; the coal being supplied to these from roads of the height of the several seams, for which small ponies to the number of 150 are employed; no horses are employed underground.

There are two engines placed on the surface, near the top of the pits, for hauling underground in the Hutton seam or lower level. The first of these is a beam-engine, with 15-inch cylinder, 3-foot stroke, cog-wheels in ratio of 1 to 3. One drum 4 feet in diameter, and main rope is only used at present for an inclined bank to the dip, or north-east, 1700 yards in length; another drum, 2 feet in diameter, on a separate shaft, was used for a tail rope, but this is now disused; both ropes are enclosed in wood boxes in the east pit, and run direct to the pit, over 6-feet pulleys at the top and at the bottom. The other engine was originally erected for pumping only, but has since been adapted for hauling purposes. It has one 24-inch horizontal cylinder, 4-foot stroke. Two drums, 4½ feet in diameter. The engine is placed at right angles to its direction to the pit; one of the drums is put in motion by wheels in ratio of 1 to 2; the rope is passed over a turn sheave to give it the proper direction to the pit. The other drum stands at right angles to the former, and is driven by two bevel wheels of equal size, and two cog-wheels of equal size; these ropes are carried down the west pit in boxes; and each drum and rope works a separate inclined bank; the bank to the south-east is 1600 yards in length to its extremity, this with two intermediate branches from it are worked by gravity inwards. In these branches by means of a cross measure dip drift westward, and a connecting curve, the engine is made available to pull from the lower seam also. The north-east inclined bank is 1900 yards in length to its extremity, having sufficient dip for the tubs to run in by gravity with the rope; there is one intermediate siding or stopping place made alongside the main line.

Near to the 24-inch engine a pit is sunk for the pumps, 28 fms. in depth; a communication is made at this depth to the coal pit, by which the upper feeders of water are brought to the pumps; the engine pumps at nights only, by direct action with connecting-rod and two quadrants placed over the pit. There are two close-topped bucket-lifts, 8 in. in diameter (one worked from each quadrant); both unite into one main pipe of 9-in. in diameter, which delivers at the surface. Water is also drawn at the end of each week by the east winding-engine, in wrought-iron tanks, but not to any extent. A cistern is fixed about half way down the coal pit, from which wrought-iron pipes convey water to supply the boilers underground, 1½-inch pipes to one boiler and 2-inch pipes to the other, the pressure of water at the boilers being 100 lbs. per inch.

There are nine plain cylindrical boilers on the surface, varying from 30 to 40 feet in length, and 6 feet in diameter to supply the east winding-engine and two hauling-engines with steam at 38 lbs. pressure. The boilers are all hand-fired, and are fed by a 7-inch cylinder inverted, with 10-inch stroke. Each winding-engine is provided with a counter-balance, working in a staple of 14 fathoms in depth, which is sunk behind each house. A three-linked chain and 3-ft. drum are used in connection with the balance-weight for each engine. The pulley-frame for the west pit has recently been reconstructed of wrought-iron in place of wood.

The framing consists of four legs and back stays, formed of angle iron and lattice work. There are six coal screens to each pit, and a vertical elevator for the nut-screen; these, with the pit platform and the east pit framing, are all of wood, which is intended to be substituted for iron when renewal is required. A 12-in. horizontal engine is used to drive the circular saw. The Usworth coal is all conveyed from the colliery on the North-Eastern system. Two trains, of 300 tons each, are sent daily by rail to London, to be used for the manu-

facture of gas, for which purpose this coal has a great reputation—excepting the Low Main coal, which is adapted for raising steam, and is principally used for that purpose. No tubbing was used, in the two old pits, but several fathoms of it have been inserted in the new air-pit. One point in favour of the machine system of ventilation is the absence of the destructive effects of highly-heated furnace upcasts, which in deep pits, where tubbing is inserted, have necessitated renewals in brief periods comparatively with downcast pits.

#### RATING OF MINES.

SIR,—The numerous letters published in the *Mining Journal*, by various writers, has rendered a great service to our mining engineers, coalowners, and ratepayers. I confess my obligation to all the writers on the subject, but more particularly to the able "C. E. and M. E.," who is evidently well up in his work; and as I have no doubt every mining district will, ere long, insist upon having all mines rated on their value to rent from year to year, and not as heretofore, by what one of the speakers in the Black Country a short time ago designated "the haphazard rule-of-thumb game." One district will not be rated on one-third of the sales, or one-twelfth, as the case may be, because the adjoining parish is so rated; each district will be valued by a competent engineer, who will rate each pit on what it is worth to let from year to year, which is, doubtless, the only just way to proceed.

One of your writers took up a view I am not master of; and I do not remember that competent writer, "C. E. and M. E.," noticing "that the first thing is to set aside a portion which shall recoup the owner for the corpus, which is daily on the wane as the colliery works." I have directed a little thought to this subject, and made some enquiry, which results in a conviction so far in the opposite direction. The first question to ask is—Who pays the rate? Is it the lord or the tenant?—Answer: The tenant pays the rate, and the lord never asks or cares whether he pays any rates at all. Taking this evidence as correct, and I believe it is so, I cannot understand what the value has to do with such an item as providing for the corpus. Whether I am right or wrong on this point, I hope "C. E. and M. E." will find time to give your enquiring readers the benefit of his valuable opinion on the subject.

I find that at a late vestry meeting in Birmingham the subject of coal rating again cropped up; and, from what I can learn, the mines there are rated in this or that way, because some other places are so rated, and not as proposed by your able writer—"on their yearly value." Great commotion and discontent has prevailed in this part for a long period, and now it begins to look like a want of confidence amongst the governing body. I hope early next week to be so far informed on this matter as to be able to write you fully on the facts.

I hope the mining interest in general, and the mining engineers in particular, have given the very able letters published in the *Mining Journal* their best consideration, as I feel confident that parish authorities, as men of business, must direct their attention to this rating question, and do justice to all.—*Dudley, Nov. 23.* LOOKER-ON.

#### COAL-CUTTING MACHINERY.

SIR,—In the *Journal* of Saturday last there is a letter from Mr. Rothery, in which he refers to the report which appeared in the issue of Oct. 29 in reference to Hurd's Coal-Cutting Machine. He writes—"The machine described by your correspondent was considerably exaggerated." I presume the report of what the machine did, and not the machine itself, was what is termed exaggerated. Having thus impugned the correctness of the report, it is to be regretted that he did not point out what part of it was incorrect. Mr. Rothery, I understand, never saw the machine at work—if he has seen it at all, which I doubt very much,—yet he has the modesty to assert that the report of a gentleman who saw it in operation was exaggerated. Mr. Rothery further states—"As to the capabilities of Mr. Hurd's machine I cannot say much." Nobody expected he could; but yet he considers the report alluded to "considerably exaggerated." How he arrived at that conclusion he wisely keeps to himself. He then says—"The possibilities set forth should be cautiously regarded." What the "possibilities" are perhaps Mr. Rothery would explain, unless the word is used as being a long one, for it certainly is in every way meaningless.

Now, Sir, having seen the machine at work I can endorse what has been written concerning it, and the manager of the Pilley Colliery, as well as several of the men who saw it at work, will also bear like testimony I have no doubt. Mr. Rothery is himself an inventor of coal-cutting machinery, and one would expect that as such he would not show such a strong animus when alluding to others engaged in similar pursuits. The coal fields of England are of vast extent, and surely there is room enough in which all inventors can introduce any machinery by which the most laborious part of the collier's work will be superseded, giving increased security to life, and raising coal cheaper than at present. I do not think, however, that those objects will be at all promoted by such dog-in-the-manger criticisms as those of Mr. Rothery. Such carping can only result prejudicially for those who indulge in them, as they show not only a want of courtesy and candour, but are opposed to those feelings of consideration for an honourable rival in the same business which is one of the true characteristics of the gentleman. *WHARNCLIFFE SILKSTONE.*

#### COAL-CUTTING MACHINERY.

SIR,—In reference to the saving by my machinery over manual labour, I beg to correct an error in my letter of Nov. 10, regarding the saving of one-eighth, which should have been one-third, over hand-labour in all cases. The 8d. per ton mentioned by your correspondent of Oct. 29 referred to the saving at Wharncliffe Silkstone Collieries only. *F. HURD.*

*Albion Foundry, Wakefield, Nov. 24.*

#### COAL-CUTTING MACHINERY.

SIR,—By some means or other a mistake has got into my letter, published in the Supplement to last week's *Journal*. The price per lineal yard varies from 16s. to 11s., should have been from 6d. to 11d. Would you be kind enough to correct it in next week's *Journal*? *J. ROTHERY.*

*Waterloo Main Colliery, Nov. 23.*

#### SAFETY-CAGES.

SIR,—Although each year the reports of the Government Inspectors of Coal Mines show a continuance of the heavy loss of life from shaft accidents, no persistent efforts seem to have been made to introduce safety-cages generally. Whether this arises from the imperfect character of the cages which have been proposed, or from the opinion which very generally exists amongst practical men that the adoption of safety appliances causes carelessness on the part of the workmen, I do not know, but I hear that the latter is the principal cause of their not having been used. Assuming this to be so, I should think there would be no difficulty in designing some arrangement which, although not even within the sight of the engineer, should come into action in cases of emergency.

Several arrangements which I should think would be well calculated to meet the requirements of the case have been described from time to time in the *Mining Journal*, yet I am not aware that one of them has come into general use. About the time of the International Exhibition of 1862 there was a Belgian invention described, I think, as one of the articles exhibited, and the inventor was Mr. Nyst, but what part of Belgium he lived in I do not recollect. The arrangement consisted of a pair of forks so placed on the top of the cage that the tension of the winding-rope pulled them off the guide-rod. So long as the rope was perfect, of course the cage could move freely up and down; but, in the event of breakage, the whole weight of the cage was thrown upon the forks in such a way as to force them to grasp the guide-rods and prevent the further descent of the cage. A still more simple arrangement was that of Mr. Aytoun, of Edinburgh, which consisted simply in placing a plate on each side of the cage, and a pair of studs on each plate on each side of the guide-rod. The tension of the winding-rope keeping the plate in a horizontal position, left the studs free of the guide-rods, but upon breakage the plate, having nothing to support it, fell, and the studs gripped the guide-rods. Neither of these appliances would cost 5s. to apply (if they were

made by the smith on the works), and if they only saved 100 lives annually it would surely be worth while to use them. The apparatus should be so placed that the engineer need not know of their existence, and, as it would not be difficult to arrange a tell-tale, and inflict a fine whenever they were suffered to come into use, carelessness could not exist without discovery.—*Nov. 22.* PHILLOS.

#### COMBINED ENGINES.

SIR,—Being at all times anxious that the originator of an improvement should at least have the credit of it, I would ask for a brief space to refer to an engine which has recently attracted some attention as a novelty, although I believe it originated with one of your old correspondents, and has been both described and illustrated in the *Mining Journal*. I need scarcely say that I allude to the engine put into the Kirkstall by Messrs. Allibon and Noyes, of Northfleet, and that I attribute the invention of that engine to Thomas Craddock. The engine consists of combined high and low pressure cylinders, placed one above the other. The high-pressure cylinder is 12½ inches diameter, and the low-pressure cylinder 33 inches, the stroke being 2 feet. The manœuvring of the engines is effected solely by the small cylinder. A pair of these combined engines are used. The slides of the large cylinders are actuated by a single pair of eccentrics, loose on the main shaft, and driven ahead or astern by snugs as in the old hand-gear engines. The eccentrics for the small cylinders are four in number, driving two fixed links, in which a sliding block traverses, so as to keep the lead always right. It is said that a boy of 12 years old can handle the engines with the greatest ease, and that they go ahead or astern at the turn of a little hand-wheel, the shaft revolving inside the loose eccentrics, and taking them up at the proper time with ease and certainty. The two pistons travel in the same direction at the same time, but instead of fitting the two pistons on to one and the same piston-rod, and having a single central gland or stuffing box communication between the two cylinders, Mr. Allibon carries the piston-rod of the smaller cylinder upwards through that cylinder cover, and on to its outer end fixes a crosshead, and connects it to the larger piston by means of two side rods or piston rods, working through glands or stuffing-boxes in the open or uncovered annular portion of the upper cover of the larger cylinder, and they may also work in suitable guides mounted upon or fixed to the outside of the small cylinder. The steam as it is exhausted from each end of the smaller cylinder is by means of a short connecting pipe admitted to the corresponding side of the piston of the larger cylinder, where at its reduced pressure due to the degree of expansion it exerts its force upon the larger surface of the piston during its stroke; when the communication with the condenser is opened, and the attenuated steam is admitted thereto, and the more or less perfect vacuum within the condenser is brought to the aid of the return stroke of the larger piston on the one side, whilst the steam pressure is acting on the opposite side to move the piston in the same direction, in the way common to all condensing engines.

For actuating the slide valves in different degrees at different times for governing the admission of steam to both cylinders, Mr. Allibon employs the double eccentric, and an inverted link for operating the slide valve of each of the high pressure engines which may be single ported. The exhaust steam-pipe from the larger cylinder is carried direct to the condenser, which in a pair of combined inverted cylinder engines, having the two valves of the larger cylinders working back to back, each in its own valve-chest, may be conveniently placed between the upright frames of the engines, and at the back thereof, or each engine may have a separate condenser, upon which the engine cylinder may be mounted, and so utilise it as a framing.

Now, this appears to me to describe the invention of Thomas Craddock, illustrated in the *Mining Journal* of July 17, 1869, as accurately as need be, and if this be the case I cannot understand how any patent secured after the date of that publication could be valid. I am aware that at the time the invention was published Mr. Craddock had not the means to patent it, but surely this should not deprive him of the credit of having designed so useful and valuable an arrangement. If there be any novel feature in Messrs. Allibon and Noyes's arrangement, I think they might at least state that theirs is merely a modification of Mr. Craddock's design. *J. L. K.*

*Nov. 22.*

#### PEAT FUEL.

SIR,—A very striking proposition has been made in the United States, and as it seems to me that if it should prove successful it would be of immense advantage to Ireland, I shall be glad if I may briefly notice it in the *Mining Journal*. It is proposed to use a combination of peat fuel and bituminous coal for the generation of steam, the principle evidently being the same as that involved in the use of bituminous coal and anthracite in combination with each other—the lighter fuel assisting the burning of the heavier. In the case of bituminous and anthracite coals it is said that the former permits all the small anthracite to be consumed, and it might be the same with peat and bituminous coal.

It would be easy, I think, to dry peat sufficiently to permit of its being granulated, and if the peat and small coal, which could be very cheaply purchased, were ultimately mixed and combined in the proportion of about three parts peat to one part coal, the whole being formed into compact bricks by the assistance of a little lime and water, I believe a very cheap and excellent steam fuel would be the result. It is likely that some improved form of furnace would have to be devised, as the lime in the fuel might damage the bars, but this is a difficulty that could easily be surmounted with furnaces at present in use.

This, I think, would give Ireland a cheap fuel, which would permit of the development of its industrial resources to an extent which at present the most enthusiastic have scarcely hoped for. I see no reason why, with such fuel, steam-power should not be obtainable in many parts of Ireland as cheaply as at Bolton or Manchester, and then, indeed, we might anticipate a brilliant and prosperous future for Ireland. *F. H.*

#### PRACTICAL MINING.

SIR,—To the end of time some mines will be rich, whilst others will be poor and worthless to the investors or proprietors of mining property; such has been the case from the earliest records in history. The profits derived from the working of mines depend upon various circumstances; in the first place, on the situation of the property and nature of the ground—whether congenial, and likely to yield large or small deposits of mineral; ground not too decomposed or hard has been found to contain the largest and generally richest deposits of mineral, but exceptions may be found. Very soft ground becomes immensely troublesome and expensive to work in depth, and ought to be wrought on the principle of working quarries. Whether the royalty or dues are reasonable or otherwise, the land carriage has much to do with its success; for example, a copper mine yielding mineral of 5 or 6 per cent. has no chance with mines yielding from 10 to 20 per cent. The heavy water charges cripple half the deep mines in existence; besides, the dressing charges or costs are treble in the preparing of inferior ores for the market to that of rich ore. The quality of some minerals found in the same locality varies considerably; for example, a soft or malleable copper will sell at a much higher standard than a harsh or brittle ore, the latter quality being the most extensively found in all quarters of the globe. A mine yielding 500 tons of ore monthly, selling at 4s. or 5s. per ton, compared to another mine selling or returning the same quantity of ore at from 10s. to 20s. per ton, leaves a very large margin to the credit side of the balance-sheet at the end of the year.

These remarks not only apply to copper mines, but to iron ore mines, tin mines, as well as lead mines. Lead ore sells at from 10s. to 20s. per ton, according to the quantity of silver found in the ore; tin ore, from 65s. to 80s. per ton in the ore. Rich mineral requires not half or one-third the cost of dressing; none but practical men, however, can clearly understand these facts.

I have had but little experience in the working of coal mines, though I did discover one coal mine, whilst the inhabitants in the locality protested for about two years that no coal would be found in the set or grant; at 76 yards from surface I found a bed of coal, from 3 to 4 ft. thick, of rather superior quality, to the astonishment of all the gentlemen and practical agents in the district. Some

100 live apparatuses, and some of the most perfect of the kind ever constructed. The engine of North-Thomas pressure cylinder, which was the first of its kind, was a sliding valve, and was fixed to the cylinder, and was not connected from the larger expansion during opening, or less of the steam.

differenters, Mr. for ope larger of com may be and denser, use it as Crad- is accu- and how valid, r. Crad- not de- able an and theirs is L. K. United it I may a com- ation of ived in each In the former t be the t of its be very the pro- being me and be have out this at pre- id per- which see no able in er, and future F. H. ers will ing pro- istory. Various property to yield or best de- ground, and "heather mine, a consi- much being A mine, com- of credit mines, to 204. in ore, not half, ever, mines, in the und in coal, ment Some

farther revelations will shortly appear, equally marvellous, and will, doubtless, be the pioneer to greater perseverance in certain localities. When mines are worked out, and fall into the Stannary Court to be wound-up, the calamity is great, and, probably, in many instances owing to the proprietors demanding too large dividends when a mine is rich, and not allowing the directors or manager to explore more ground. Many results prove that the greatest amount of wealth remains still undeveloped.—London, Nov. 23. A. BENNETT.

#### PERCENTAGE OF GOLD IN THE NOVA SCOTIA QUARTZ.

SIR.—I have just received from Mr. A. Heatherington, of Halifax, Nova Scotia, his interesting little pamphlet, entitled "The Gold Yield of Nova Scotia—1860 to 1869," in which this able writer, to whom we owe already so much interesting information on the gold fields of that district, has published a tabular account of the yield of these mines from 1860, when they were first worked, to the end of last year.

It appears from this marvellous array of figures, most carefully and laboriously got together, that the largest yield of gold per ton of quartz has been 3 ozs. 7 dwts., and the smallest 4 dwts. If we could judge from these two figures alone (which we may not) the average would appear to be about 1½ oz. per ton, and they might prove some kind of guide to those who turn their attention to gold mining in Great Britain: 1½ oz. of gold per ton would, indeed, be well worth working almost anywhere, provided there was an abundant supply of the auriferous rock, and many South American mines are, I believe, working much less.

But the true mean of the Nova Scotia gold fields, according to Mr. A. Heatherington, is 17 dwts. 123 grs. This, as the author observes, is much higher than the average yield of several South American gold mines now at work. I cannot help thinking, however, that at least 1 oz. per ton should be looked for if success is to attend the undertaking. One mine, I see, has obtained 15,617½ ozs. from 18,733 tons of quartz, another 1029 ozs. from 532½ tons, and another 11,994½ ozs. from 9896½ tons of quartz. These figures may interest some of your readers. Some writers have stated lately in the *Mining Journal* that certain English gold deposits have never been thoroughly tested, and I believe they are right. Geological surveys and "prospectors" are not sufficient to prove that a given district is auriferous or not. The rock often contains notable amounts of gold when none is visible to the eye, and it is not improbable that some of our Scotch, Welsh, or Irish rocks will be worked for gold, one of these days, by some chemical method, and yield surprising results.

Analytical Laboratory, Putney. T. L. PHIPSON, Ph.D., F.C.S.

#### MINING IN IRELAND—THE CAPPAGH MINE.

SIR.—Lamentable as it may appear, it is no less a fact that of late years there has existed an exodus of skill, labour, and capital tending towards the metallurgical fields of each quarter of the globe to the serious neglect of those at home, where really excellent properties are so frequently cropping out, and urgently inviting attention, with a promise of ample remuneration at an early date. Without a question of doubt, foreign countries offer tempting baits, and in some few instances have yielded encouraging results, especially in the precious metals—gold and silver; but compared with the disappointments, resulting from exaggerated reports, mismanagement, and extraordinary expenditure, the compensation in the aggregate has not proved equivalent to the anticipation. In the meanwhile, at a comparatively short distance from the nucleus of English enterprise and capital, there exists a safe and unobscured channel for the employment of both, to say nothing of a means of rendering a large section of the community happy and prosperous—in fact, a safe expedient of investment in contradistinction to the questionable speculations in foreign mines, of which at the present moment the name is legion. I need scarcely stop to particularise the objections that present themselves in distant fields. All must acknowledge those involved in uncertain alliances, delay in correspondence with the executive, verification of reports, expenses involved by inspection, and the ruinous cost and procrastination in local management, when skill and honesty are required to supersede incapacity and speculation.

I am induced to offer these strictures, not because there is a lack of encouragement in exotic mineral resources, on the contrary, evidence is strongly in its favour, but because our home produce exhibits so striking a proof of the inexhaustible wealth supplied by a bounteous Providence for home industry. In this respect Ireland offers a most remarkable instance. Having visited every portion of its explored mineralised surface, I speak confidently of its natural resources. Recently my attention has been called a district which, though I had previously explored it, I find is about to excite attention beyond every other of a kindred description. Situated at Ballydeob, east of the long-celebrated mine of Berehaven, is the Cappagh Mine, noted for the richness of its cupreous ground, and promising to eclipse its hitherto successful rival of Berehaven. Having been invited to pay a visit of inspection to the large collection of specimens of ore recently arrived from the mine to the office of the company, 15, Finsbury-place South, I accepted the invitation, and indiscriminately selected three samples from the heap, and these I must, in fairness, add constitute a faithful type of the bulk. They consist essentially of blue and grey sulphides, the exceedingly rich variety known as "horse-flesh," and green carbonate. As cabinet specimens they are superb; but, practically, each manifests extraordinary richness, whilst collectively they warrant the assurance of cupreous wealth, anxiously and naturally sought for by all who select mining operations as a means of investment or legitimate speculation: I append the following as the result of my assays:—

No. 1—Copper .....	48.5 per cent.
No. 2—Copper .....	46.0 per cent.
No. 3—Copper .....	54.5 per cent.

Thus averaging 49.6 per cent., and this, as I have stated, from samples taken up promiscuously, and retaining their attached gangue or matrix, and the product of the material as it was presented from the lodes in its solid and compact condition. Supplementary to the pleasing results thus furnished, I may refer to the historical records which exhibit the Cappagh Mine for a very long period of time, maintaining a prominent position as a profitable engagement, and only languishing through paucity of capital and concomitant impediments. These have hitherto retarded its inevitable progress towards the position of a really first-class remunerative concern. Originally the property of Lord Audley, the Cappagh Mine by a decree of the Irish Encumbered Estate Act was sold to the West Cork Mining Company for the sum of 165,000£. The working ceased simply from the inability of the purchasers to complete the purchase. Subsequently its fortunes have been subject to vicissitudes. Documentary evidence affords incontestable proof that under every phase the *bona fide* value of the sett was unassailable, and establishes the conviction of its immense wealth, and tends to inspire confidence in its intrinsic worth.

As a subject of legal examination in the House of Lords, the Cappagh Mine gave rise to a voluminous document, the evidence eliciting the fact that the original valuation was strictly reasonable and equitable. Amongst the numerous authorities then called up I shall content myself with quoting the evidence of three gentlemen. Mr. Frazer, Collector of Her Majesty's Dues in Cornwall and Devon, states that "the ore in these mines is of much greater value, and richer, than any copper mines in Cornwall, or in any district in the United Kingdom—only equalled by those of Greenland and some parts of Hungary." Capt. M. Luke, "an experienced Cornish mine agent," described the Cappagh Mine "as superior to Cornish mines," and estimated the value of ore in sight as amounting to 155,400£. Mr. Barker, director of the Mining Company of Ireland, deposed that, "exclusive of the Cappagh Mine, there were indications in various other parts of this estate which led to the full persuasion that they would form the most important metalliferous district in Ireland." At the period referred to the drivings had not penetrated to anything like the present workings. Subsequent researches confirm the additional remark of Mr. Barker, that "the deepest part of the mine produces the richest ore, and in greater abundance than that of the higher levels." Judging by the ore now being brought to grass, it may be justly inferred that at some yet greater depth the metalliferous wealth will culminate in quantity and quality hitherto unequalled in the United Kingdom.

I hesitate to add more upon this score, lest I be suspected of be-

coming partisan instead of exponent. Recent official reports will doubtless furnish information of the existing state of the Cappagh Mine. It appears to be sunk to a depth of 94 feet, and every level (placed, as I believe, at intervals of 10 feet) struck upon rich ore ground. It possesses a pumping-engine equal to any emergency to a depth of 350 fathoms; and there is an ample supply of first-rate machinery. Such being the capabilities and position of the Cappagh Mine, it is easy to foretell its early destiny. Comparatively unknown, it is unappreciated. I shall be glad to find this notice result in the strictest enquiry. The merits established, it will only remain with the executive, by judicious agency in regard to capital and labour, to secure for the mine a prominent position upon the Dividend List, giving healthy and legitimate stimulus to a long-neglected source of imperial prosperity.—Mining in Ireland. W. WHITE. Laboratory and Assay Office, Nov. 23.

#### MINING IN CARDIGANSHIRE.

SIR.—Having just returned from inspecting some mining property in Carnarvonshire, I may be allowed to continue my reporting upon the mines in this neighbourhood.

In my last letter I brought the reader as far as WEST ESKAIR LIE. I then spoke of an anticipated improvement in this mine, since which time, in the bottom cross-cut driven south, they have met with a bunch of lead ore of a very good quality, and with a little further driving I should think they would come upon the lode expected. There is also a cross-cut being driven south from surface to the east of the present engine-shaft some distance into the hill—about 34 fathoms. Here they have also intersected the lode. This lode, which is about 4 fms. to 8 fms. wide, will give them a little work to do before speaking of its character; at present it has every appearance of being of a fine masterly one, which I really believe to be the Van lode, strongly impregnated with blende, strong gossan, beautiful spar, &c. Doubtless, by-and-by all these strong indications will fall into a well-defined lead lode, and come forth a veritable Cardiganshire Van. I should like to see it, deserving as the mine does a higher step in life.

Our next neighbour is the WEST BRYN GLAS, a continuation of the lode spoken of above. This valuable property is now carried on by a local party, and to the best of my knowledge of mining in this part of the world. A better speculation cannot be found in the county, embracing near the whole of the lodes in the district. I have seen four lodes running parallel east and west, continuing their run to the River Rhedol, and to the celebrated Bwlch Gwyn Mine, of which more will be said anon. How many more lodes may and will be found is more than I can at present tell. Pits and levels, cross-cuts, and shafts are being wrought on this property, and every facility that a miner can desire—such as water, roads, hills, and valleys—are to be found here. I wish them what they deserve—great success.

The Castle river is the boundary between this sett and the GLAN CASTLE, close to the well-known Eliza's Corner. This mining ground has been worked for some little time, and is well worthy the trial of being sunk and driven upon, as the present appearance of the western end, which has been driven from the brink of the River Castle about 18 fms., 12 fms. of this distance being on the lode, composed of clay-slate, in which may be seen some beautiful strings of rich lead ore, copper, spar, &c., and being very near the Old Bryn Glas—in fact, running into it—where lead at one time sold for a very high price, the ground in and continuing westward to the Ponterydd range of mines being all virgin ground; and any party of gentlemen who may feel disposed to go into a good mining speculation cannot fail by at once selecting any of the many good grants that are now exposed to view in this part of Cardiganshire.

We will now proceed to the Ponterydd range, and first speak of the CLARA MINE. Here the proprietors are going to work in a very spirited manner, and it must soon tell a tale for itself, as, having all requisite machinery, it will soon come forth into the market even higher than it stood years ago, when only 20 fms. deep—in fact, it is only now 30 fms. deep from surface; therefore, let it go on for while to another sink or lift, and then I predict that it will become a most valuable property.

Before proceeding further west I would direct attention to the BWLCH GWYN MINES, immediately to the south, which is the same run of ground, the same lode as I suppose the West Eskair Lie to be upon—the Van; but so much deserving of late being said and written concerning this mine it certainly deserves a better fate. If I may be allowed to give a word of advice, I would say try and assist our neighbours, instead of running down people and property; it injures many, and does no good to any. Rather follow the footsteps of our forefathers, who were practical miners; and if this had been done I doubt not that at this time many more good mines might have been opened, and new ones started, to the advantage of the adventurers and the benefit of the many poor labourers of this corner of our mining vineyard.

Continuing to the west of Clara, we come upon the LLYWERNOG, the property of a London party, under the management of Mr. Talcombe. Here they are busy stripping down the shaft, but little else can be done until this is completed; consequently, we will leave it to the agent, Capt. Davies, until another opportunity, and speak a little about the adjoining POWELL UNITED MINE. Here the glory of its riches is not only revealed to the eyes of the mining public, but shared by the rich and lucky proprietors. This mine, which is down from surface 72 fathoms, cross-cutting to the lode, is selling 50 tons of lead this month, but until this, 45 and 40, down to 30 and 25 tons, which shows a continual improvement. Old mines and old men all mistake: this mine, once dead, was re-opened and revived by my dear father, who has been called away from rendering any further assistance, but the mine tells its own story—what it has and will do, perhaps, for ages to come; therefore, never say too old or too deep, but go on and hope to prosper.

Next week I hope to bring under notice the few mines further west. Aberystwyth, Nov. 22. SAMPOSON TREYETHAN, M.C.E.

[For remainder of Original Correspondence see to-day's Journal.]

#### FOREIGN MINING AND METALLURGY.

There is no very good news to give as to the state of the Belgian coal trade. Every day adds to the difficulties of the situation, and it cannot be denied that it has become very grave in consequence of the continuation of the war. At present the coalowners have done their best to conceal their embarrassments, but stocks have accumulated to such an extent that in consequence of the impossibility of clearing them off coalowners will be obliged soon to restrict their production. The severe strain to which all industries using coal and iron are being subjected will contribute to render the position even less tenable, and to this state of affairs no immediate remedy can be applied. It will probably become the duty of the coalowners to propose to the Government some means of mitigating the effects of the crisis. The La Haye Company will pay, on Dec. 1, its second dividend for 1869-70, or 10s. per share.

The Franco-Prussian war has given a rude shock to Belgian metallurgical industry, and as if this were not enough, a second "difficulty" has clouded over the European horizon. It may be hoped, however, that this second difficulty will be amicably adjusted. Russia and Turkey are both valuable clients of Belgium for rails and other descriptions of railway iron, as well as for locomotives and railway plant, and any possibility of losing even in part such important outlets is, of course, a cause of great anxiety to Belgian mechanical and metallurgical firms. It is stated that already two important contracts which were in course of negotiation for railway plant for Russia have gone off, at any rate, temporarily. The Belgian blast-furnaces may be said to be living, like Bohemians, from day to day. What would be their position if the principal European outlets were closed to them? The dividend of the Jemmapes Rolling Mills, Forges, and Foundries Company has been fixed for 1869-70 at 10 per cent. per annum.

At Marseilles, Toka copper has made 76£ per ton; Spanish, 68£; and refined Chilean and Peruvian, 76£ per ton. Affairs are in rather a languishing state upon the German markets, especially in consequence of the high price which combustible has attained. The arrivals have also been few and unimportant, and the foundries have been compelled to restrict their production. At Rotterdam prices of copper have presented little or no variation. As regards tin, it may be observed that at Marseilles prices have experienced comparatively little change. In Germany the position of the article has slightly improved. At Marseilles lead in saumons, first fusion, has made 17£ per ton; ditto in shot, 20£ per ton; rolled and in pipes, 20£ 16s. per ton. At Rotterdam, Stolberg and Eschweiler have made 11½ s.; and German of various marks 10½ s. Rolled zinc has been dealt in at Marseilles at 28£ per ton. The German zinc markets continue quiet, and no revival is anticipated in affairs before the close of the winter. At Hamburg the tone of the zinc market has been rather feeble.

The Essen Chamber of Commerce has published its report for 1869. It appears that last year 221 collieries were in working in the Dortmund district, and produced 226,225,290 bushels of coal, of the value of 20,749,293 thalers. The number of workmen employed to secure this result was 52,299. On comparing the statistics of 1869 with those of 1868, we find an increase of 16,096,442 bushels in the production, an increase of 1,677,056 thalers in the value, and an increase of 2552 in the number of workmen employed. The production of the Essen district in 1869 was spread over 63 collieries, and amounted to 73,224,716 bushels, representing a value of 6,515,427 thalers; the number of workmen employed was 14,490. In 1868 the number of collieries worked was 64; the quantity produced was 70,125,744 bushels, representing a value of 6,139,077 thalers; the number of workmen employed was 14,383. In 1869 the number of steam-engines in use in the Essen district was 176, of a collective force of 17,097

horses, as compared with 155 engines, of a collective force of 15,874 horses, in 1868. The demand for the coal extracted in the Dortmund and Essen basins experienced a sensible increase last year; in fact, it became difficult to satisfy it. The increased demand had some influence upon prices, and especially upon coke. The sales effected of Dortmund coal in 1869 amounted to 213,596,590 bushels, as compared with 192,810,900 bushels in 1868, and 160,735,020 bushels in 1869. The number of bearings of iron minerals worked last year in the Dortmund district was 47, employing 2765 miners; the value of the extraction effected was estimated at 804,482 thalers, showing an increase of 104,389 thalers upon the corresponding total of 1868. The value of the iron minerals raised in the Essen district in 1869 was estimated at 145,520 thalers; the number of workmen employed was 648, and there were, besides, at work four steam-engines, of a collective force of 390 horses. The value of the corresponding production effected in 1868 was 92,232 thalers.

#### IRON, AND ITS MANUFACTURE.

An interesting and exhaustive address upon this subject has been delivered before the American Institute by Mr. A. W. HUMPHREYS, treasurer of the Sterling Iron and Railway Company, in which he remarks that a greater or less use of iron has well been pronounced a fair measure of the degree of the real civilisation and extent and variety of useful industry which prevail in modern countries, and is, perhaps, the surest single means of readily judging of any people's position in the family of nations. The manufacture of iron was one of the earliest industries, requiring joint or associated action, or the labour of several individuals, to produce one specific end, the reduction of iron ores having begun very early, and being too difficult for one man to accomplish to any extent unaided; and its production quickly necessitates a more or less crude commerce, for nowhere does a family or tribe make its own iron without also producing a certain surplus to be bartered off to the less fortunate or less skilful, and this manufacture and barter, begun almost as soon as men ceased to live entirely by the chase, has continued constantly supporting or stimulating manufactures and commerce until they have attained the stupendous development of our own day. After carefully tracing the early methods of manufacturing iron, and giving a history of the invention of blast-furnaces, puddling-furnaces, and rolling-mills, he proceeds to record the progress of the manufacture in England, the introduction of the hot-blast, and the use of anthracite coal, especially in the United States.

Concerning the early manufactures of New England, Mr. Humphreys gave an outline of the history of the industry from the date of the first known ironworks in America, which were erected near Jamestown, in Virginia, in 1615 or 1616 to the present time. The make of pig-iron in the United States, which was about 54,000 tons in 1810, is now upwards of 2,000,000 tons, and is rapidly increasing; the increase in England in the same time having been from about 300,000 tons to about 5,500,000. It appears that even in America the value of the iron produced exceeds by more than 35,000,000 the value of all the gold and silver produced there. The total quantity of iron made in the world in 1869 amounted to about 12,000,000 tons. The changes, he continued, in the various modes of manufacturing pig-iron and tracing it to the finished article have been extraordinary and unexpected, and are still being made or attempted with rapidity which it is difficult to keep pace with. He could not forbear, although he intended not to go beyond pig-iron, calling attention to the surprising growth of the manufacture of rails in America. Thirty years ago not a ton was rolled there, the first American rail having been rolled in 1845, yet last year nearly 600,000 tons were made, more than half of which came from the works in Pennsylvania, and nearly 100,000 tons from New York, of a quality admitted to be far superior to the foreign rails generally brought there. The total supply of iron ore of all desirable qualities is practically inexhaustible, and if the manufacture need not be limited from fears of exhausting ores and fuel, neither should there be any solicitude lest there be too much iron produced. The iron production of the world scarcely keeps pace with the augmented demand, and America has never since its political independence been achieved made anything like the quantity necessary for its use, while the iron needed per capita is constantly increasing. To state that a lecture upon such a subject by one in Mr. Humphreys' position was interesting and instructive would be unnecessary; but it may fairly be said that few could give a more complete review of the history, position, and prospects of the iron trade of a country in the limited space occupied by Mr. Humphreys' admirable address.

#### THE AMERICAN IRON AND STEEL WORKS.

Among the most remarkable of all the Pittsburgh establishments is that of the Messrs. Lyon, Shorb, and Co., the famous "SLIGO IRON-WORKS." Here is made the best iron plate in the world—an article which commands in our markets a price which is a notch or two higher than even the celebrated Lowmoor, which Englishmen fondly believe is the *ne plus ultra* of plate metal. It is used chiefly for making the fire-boxes of boilers, and especially of locomotive boilers. It is admirably adapted to the purpose of resisting the destructive effects of the direct action of the fire, which it does far better than ordinary metal. Its properties are due to peculiarities in the process of manufacture. In the first place, it is derived from an extraordinary ore—the excellent brown hematite of the Juniata Valley. There is everything in what I might call the pedigree of an iron. Some ores are vulgar, ignominious, and perverse, and to make good metal from them is impossible, no matter how well they are treated. It is a remarkable fact that the best ores in the world are usually brown hematites, or the hydrated variety, being peroxide of iron, with water chemically combined. They are usually less dense, less compact and strong, more pervious to the gases of the blast-furnace, and sometimes are extremely porous, smelting with great ease, and are less liable to contract deleterious dilatations. The Sligo iron is smelted with charcoal and cold-blast. The comparatively low heat thus generated makes the iron rich enough in carbon, but prevents the reduction of other impurities which, at a higher temperature, are apt to enter it in considerable quantities. It is also conjectured that the ash of charcoal, which contains considerable potash and soda, without much silica, exercises a beneficial influence upon the metal, since these bases may, in the elementary state, form combinations with sulphur and phosphorus, and neutralise their injurious effects.

THE SLIGO IRON.—The Sligo iron is not puddled, although it goes through a process akin to it—the "finery" process, as it is called. It is placed in a small furnace, covered with charcoal, and melted, the blast being supplied through several nozzles, which point obliquely downward upon the bath of metal. After several hours of blast the carbon and silicon will have been nearly exhausted, with the formation of a large quantity of slag, which is silicate of iron, and highly basic—that is, containing an excess of iron. The loss of iron is about 33 per cent., but the slag is again used as an ore in the blast-furnace. It will be seen that the loss is very great, but it is compensated by the superior quality of the iron. After losing its carbon and silicon the mass becomes pasty and solidifies, after which it is removed and hammered into a bloom. The blooms are due to the impurities in the iron, which are repeatedly hammered down, cut, and piled, but are not rolled until the final plate is made. Hammering the billets, instead of rolling them, gives increased hardness and density, and makes the welds more certain and homogeneous. But all this is the most costly way possible of manufacturing iron. Remarkably enough, too, these methods are the old-fashioned methods of iron metallurgy, which prevailed before the introduction of the hot-blast, of anthracite fuel, and of puddling. We have improved the manner and diminished the cost, both of fuel and labour, in making common qualities of iron, but the superior qualities seem to be unobtainable, except by the older and wasteful processes of the charcoal cold-blast, the finery, and the hammer. But I mistake. We have not economised much, in this part of the country, in the cost of smelting. We make a poorer pig-iron with more fuel than anywhere else on earth.

THE ELLERSHAUSEN PROCESS.—At the establishment of Messrs. Lyon, Shorb, and Co., we witnessed the Ellershausen process. This invention, two years ago, attracted very great attention among ironmasters, and seemed to give very useful and important results. Attempts were made to introduce it into various large iron establishments, and many capitalists experimented with it. It has been abandoned everywhere about Pittsburgh, with the exception of three places, two of which we examined with great interest. The first I have mentioned, and the second is the great firm of Schoenberger and Co. Both of these establishments use it with the highest opinion of its value; and certainly no better endorsement of its merits could be had. The process is as follows:—Upon the periphery of a horizontal circular (or annular) table are small boxes or troughs placed radially. The result of this mixture is a partial action of the oxygen of the ore upon the carbon of the iron, forming carbonic oxide, which puffs up the iron into a loose, irregular, and clumpy-looking mass. When cool, it is turned out of the boxes in rough cakes or "pig blooms." These are then puddled, yielding in the puddle bar a metal which is fit to be wrought into shapes at one reheat. The loss of iron does not exceed 3 per cent., and the amount of ore used is about 10 to 12 per cent. at Lyon, Shorb, and Co.'s, and 16 to 18 per cent. at Schoenberger's. In puddling, 800 lbs. of pig blooms are charged into a double furnace, and pushed or will turn out six heats in a shift (twelve hours), netting about 400 lbs. of metal. At Schoenberger's the puddle bar is rolled direct without even on piling, into horse-shoe rods, and made into horse-shoes at a single reheat. I venture to say that this is without precedent in the history of iron-making. Lyon, Shorb, and Co. mix with their ore a very little coal tar or other bituminous matter, and with very good results. The theory of the process is as follows:—It is impossible that any great amount of chemical action and reduction should take place while the mingling of the ore and iron is in progress; but when subjected to the flame of the reverberatory furnace, the possibility and permeability of the mass enables the oxidation to go on very rapidly and efficiently. It is the mechanical condition of the blooms which facilitates the subsequently chemical changes. When the heat of the furnace is raised slowly the blooms never thoroughly melt, but soften down into a pasty state, and become infusible. They can then be taken out and rolled without any preliminary squeezing, as in the case of the puddle bar, and will yield a good iron. If the heat be raised rapidly, the blooms will melt and "come to nature."

I am confident that this process has not received justice at the hands of manufacturers. The fact that such establishments as the two just mentioned have used it with the greatest success is enough to warrant others who have tried it unsuccessfully in reconsidering their judgment upon its merits. It requires skilful puddling, and, absolutely, the puddler must not be allowed to falsify the process by working it intentionally wrong. This class of workmen are averse to any innovation, particularly one which threatens to abridge their labour; and it is asserted by

many that "the process is an excellent one, but the puddlers have killed it." The chief objection just now to the process is the lack of proper means to smelt uniformly the ore and the iron, hence the blooms vary considerably in their porosity, and do not work regularly. But this difficulty seems easy to remedy, and it is to be hoped that it will be soon. If the Ellershausen process could be worked everywhere as successfully as it now is in Pittsburgh, its value would be enormous. I cannot see why it should not be. It is sound in theory, and ought to be found universally in practice. But American ironmasters are averse to experiment; few of them are willing to make "experiments" a standing account in their books, and they prefer to trust to old methods, as long as there is the smallest margin of profit, rather than risk anything for the sake of possible improvement. Moreover, a new invention must come to them perfect and in good working order before they will consent to employ it. The seldom trouble themselves to enquire whether a fruitless experiment is due to the defective workmanship or to a defective principle. The inference is that it is the latter. Respecting the Ellershausen, we are all confident that the principle is good, and that those who have "slipped up" on it have merely been guilty of bad practice, which is excusable enough when it is remembered that it was then an experiment, and not a matured process.

—Special Correspondence, *New York Times*.

#### SOUTH AFRICAN DIAMONDS.

Prof. Tennant, of King's College, London, delivered an interesting lecture on "South African Diamonds," on Wednesday, to a crowded audience in the hall of the Society of Arts, John-street, Adelphi. The lecturer exhibited varieties of the diamond brought from India, Brazil, Australia, and South Africa, as well as many specimens and crystals found in the diamond fields of the Cape. Sir Henry Barkly, K.C.B., took the chair, and, after calling on the secretary, Mr. P. Le Neve Foster, to read the minutes of the last meeting, introduced Prof. Tennant to the audience. The lecturer began by recounting the history of the discovery of diamonds at the Cape of Good Hope. In March, 1867, Dr. Atherstone, of Graham's Town, received by post an unsealed, unregistered letter a rough diamond, which had been picked up on a farm in the Hope Town district, and forwarded by Mr. J. O'Reilly to Mr. Lorenzo Boyes, Clerk of the Peace for the district of Colesberg, who sent it to Dr. Atherstone in order that he might give his opinion as to the probability of its being of any value. He had not seen a rough diamond before; but, after taking the specific gravity, testing the hardness, and examining it by polarised light, he decided that it was a genuine diamond, of considerable value; and, perceiving the great importance of such a discovery to the colony, he at once wrote to the Colonial Secretary, suggesting that it should be sent to the Paris Exhibition, and afterwards sold for the benefit of the finder. This fortunate person was a Dutch farmer, who, seeing the children of a neighbouring boer playing with some bright stones, was struck by the appearance of one, which he offered to buy of the mother. She laughed at the idea of selling the gem, and gave it to him at once. He showed it to Mr. O'Reilly, who was returning from a distant hunting expedition, and so it finally reached Dr. Atherstone. At the close of the Paris Exhibition the stone was purchased by Sir Philip Wodehouse, then Governor of the Colony, for 500*l*. Comparing the South African with other diamond fields, he remarked that it had hitherto been unusual to receive more than one large diamond—say of 40 carats—in the course of a single year, but the new fields had yielded no less than five stones exceeding this weight within that time. He had models of many. There was one of 36 carats, and another weighing 33 carats, which arrived last year, and proved to be an exceedingly beautiful stone. It is now in the possession of Messrs. Hunt and Roskill, who had kindly promised to allow anyone who wished to see it. He exhibited a piece of diamond from this region exceeding the Koh-i-noor in size, and equalling it in beauty when cut and polished. The lecturer then proceeded, by means of diagrams, to explain the technical terms used in describing the forms in which the crystals of diamonds were found, and then described some peculiarities of the stone by which it might be readily distinguished from other crystalline minerals of somewhat similar appearance. One means was by chipping a piece of the stone, and observing the form of the fragment; but it was not absolutely necessary to apply the test of cleavage, for, as it was very rare indeed to find a diamond perfect and without a flaw, by examining the surfaces of a flaw the character of the stone might be determined. The diamond, although the hardest of substances, was one of the most brittle, and it was probably owing to ignorance of this fact, and carelessness on the part of the diamond-seekers, that so many of the diamonds brought from the Cape were broken. The principal diamond-bearing districts at present discovered were the valleys of the Vaal, Orange, and Riet rivers. A great variety of other minerals had been found in the same neighbourhood. The pebbles consisted of rock crystal of different colours, and, together with agate, jaspers (black, red, and ribboned), quartzite, garnet, spinel, peridot, blue corundum, were abundant—while iron ore, sandstone, basalt, and granite were also found in these regions.

In the course of the discussion which followed, Mr. Rabone, who stated that he had resided for eighteen years in the neighbourhood of the diamond fields, expressed his regret that this valuable region had been separated from the dominions of the Crown.—Mr. Rawlinson drew attention to the great importance of diamonds to the artisan, the mechanic, and the engineer. They were now employed for many purposes instead of steel—for drilling rocks, for facing millstones, and for piercing iron and steel.—Mr. Frondel said that the discoverers of diamonds at the Cape, he had been informed, frequently made the mistake of placing a value so exorbitantly high on the stones they sent over here to be sold that the agents were unable to dispose of them.—Mr. Le Neve Foster said they made no allowance for the loss of weight in cutting.—Prof. Tennant said that only about 10 per cent. of those found were of the first water. Many of those received from South Africa were very defective. In the large one of which he had spoken, weighing 33 carats, there were three flaws; nevertheless, 5000*l*. was offered to the finder while still in the rough.—The Chairman then moved a vote of thanks to the lecturer, which was carried with acclamation.

**DIAMOND MINING IN SOUTH AFRICA.**—A California miner who emigrated to the Cape of Good Hope in August last, in writing from the diamond fields, gives the following practical information:—

**HOW THE DIAMOND MINERS WORK.**—Most of the miners work in this manner: They first dig the gravel to the bed or to clay (generally from 6 in. to 3 feet in depth), then with a meal-sifter they sift the dirt and throw out all large stones. The middling dirt, or pebbles, they cart to the Vaal river, about, on an average, 500 yards from the mine, and there wash it in a California gold cradle; they then lay the washed pebbles on a table, and carefully sort a handful at a time with a scripper; by this means they get through about two cart-loads of sorted "casualty" a day. Some carry the water up to the mine, and after the dry sifting of the dirt, they dip the sieve in the water and wash the pebbles.

**CALIFORNIA IMPROVEMENT.**—A few days after our arrival I invented a shaking-table for dry sifting, the top sieve of  $\frac{1}{4}$  in. holes, and the bottom sieve of 3-16 in. holes; the top sieve is inclined one way about 25°, so that all the large stones will fall off by the shaking. The bottom sieve is longer than the top one, and is inclined 25° in the opposite direction; the dirt and gravel that pass through the top sieve fall on the second one, and the dirt passes through and the gravel to wash passes out at the end, and is carted to the river for washing. I could put through 6 cart-loads a day with this medium, and concentrate it to 20 cart-loads of gravel—two men can only sort out four cart-loads of gravel in 10 hours after it has been washed, and the sorting of the 12 cart-loads through in a day in consequence of this. We are now teaching some of our negroes to sort, and we will put more ground through presently.

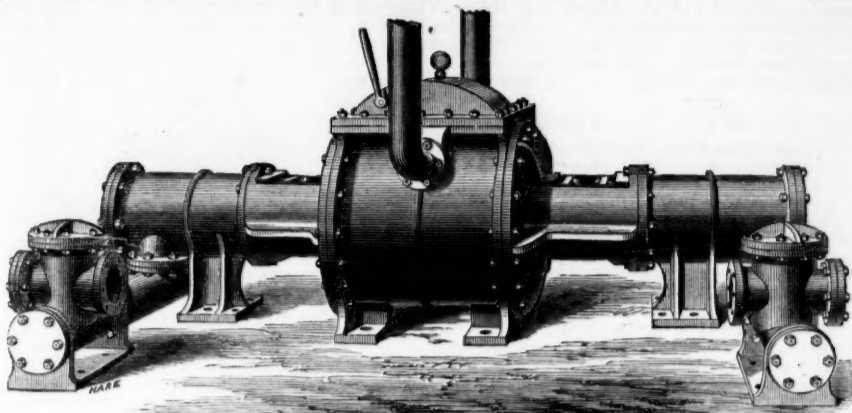
**THE DIAMOND FIELDS.**—By the last Cape mail we learn that the rush to the diamond diggings continues to prevail in South Africa, and a complete revolution is taking place in the back country of what may now be termed the old colonies. Formerly vast tracts of alluvial lands existed in the interior, with excellent sheep-walks of enormous extent, and all the processes of farming could be carried out there with facility and great success, but the difficulty lay in disposing of the produce for which the diamond discoveries now promise a great market. To provide a remedy, as a large population is growing up that will require the produce of the adjacent lands. At present the diamond fields extend over about 25 miles, and the digging population has reached to 11,000 persons. The success of the diggers promises to be continued for some years to come. Of small diamonds and other precious stones, there seems to be a large steady supply, while ever and anon the same startling discoveries in gems are made. By the Northern arrive two magnificent diamonds, very perfect in the eyes of the lapidaries; one of these gems, the Rose diamond, named in honour of the Queen, weighing 60 carats, and the other 25 carats. On Sept. 30 a still greater discovery was made—that of a diamond of exquisite brilliancy, spotless, and of good form, weighing 81-16 carats. In this case Mr. Wheeler, one of a family party of five diggers, was the fortunate discoverer; 22,000*l*. were offered for the gem on the spot by dealers, but its estimated value is 30,000*l*. and its owners have resolved on two of their number bringing it to Europe for sale. This is the greatest prize yet dug up, as it eclipses the present largest diamond found, "the Star of South Africa." Various reports have been sent about in reference to the state of the diggings, but recent visitants give a very favourable report of the population and of the sanitary condition of the country. The disputed proprietorship of the lands however, still continues, and it may occasion much trouble.

**THE AUSTRALIAN DIAMOND FIELDS.**—The success of the diamond seekers in Australia does not appear, from the last advices from Sydney, to have been so great as could have been wished. The cost of labour is so heavy, and the gems are so sparsely scattered through the wash dirt, that although Hunt's Patent Ore Separator is said to work admirably, the results are not, from a monetary point of view, satisfactory. The number of diamonds found up to the present time has been at a rough estimate about 5500, the largest having been one of  $\frac{1}{2}$  carat, and the smallest one-tenth of a grain. The average weight of all found has been about a grain. They have all been found at Two-mile Flat, on the banks of the Cudgegong, a great many of them in the old tailings left by the gold miners, but some few accidentally in the bed of the river. They are always accompanied by rubies, topaz, and other gems, but these are not of a size to give them commercial value. The Australian Diamond Company, of which Mr. Hunt is himself the manager, has been compelled in consequence of the high price of wages to suspend operations, and Mr. Hunt estimates that diamond mining will not pay a company unless 2 dwts. of gold, and one diamond of a grain weight be found in every load of wash. Diamonds have also been found on the Mero, and in the vicinity of Dubbo. At the latter town a local company has been formed for the purpose of diamond seeking.

**NEWFOUNDLAND.**—A correspondent states that a mine containing large quantities of silver has been discovered near The Cove, Newfoundland; that several specimens of gold have been also found near the same place; and a mining party started from St. John's last month for the scene of the discovery.

**LONDON GENERAL OMNIBUS COMPANY.**—The traffic receipts for the week ending November 20 were 8945*l*. 8s. 5d.

## NEW STEAM PUMPING ENGINE, FOR MINES AND QUARRIES



An event of considerable importance to the mining world has just taken place in South Wales. We refer to the successful starting of a Steam-Pumping Engine on an entirely new principle, which promises to be of the greatest utility to the owners of mines and quarries. Hitherto it has been the practice of mining engineers to place the pumping-engine on the surface, connecting it with the pumps at the bottom by rods or spears, an arrangement too well known to our readers to render any description necessary.

The pumping-engine of Messrs. HAYWARD TYLER and Co., of Upper Whitecross-street, London, to which we refer, is a direct-acting self-contained engine, having no fly-wheel or gear. It consists of a steam-engine of 40-in. diameter, with a single-acting plunger-pumps of 8-in. diameter attached to each cylinder cover. All working parts, with the exception of a few inches of plunger, are entirely encased. In fact, by the addition of a cover on this particular part there is no

reason why the engine should not go on working if a fall took place and it were buried beneath tons of material.

From this slight description of the machine it will be seen at once that it is especially designed for use in the workings, steam being carried to it by pipes, thus obviating the enormous expense of fixing those huge and ponderous machines now in general use in mines, effecting an immense saving in first cost.

This pumping-engine, the weight of which is only 6 tons, is raising 15,000 gallons per hour in one vertical lift of 670 feet, and fixed in the working about 250 yards distant from the main shaft the Broad Oak Colliery, Loughor, near Llanelly, the property of JAMES BANFIELD, of Swansea, who deserves great credit for enterprising spirit he has shown by thus leading the way in the line of modern improvements.

We give an outside view of the Pump, which shows the arrangement so clearly that our readers will require no further description.

#### GOLD AND SILVER—SUBSTITUTES.

The desirability of finding additional uses for the common metals—copper, zinc, and tin—has frequently been pointed out in the *Mining Journal*, and Mr. A. L. DOWIE, of Glasgow, has now patented an invention, the chief object of which is to give greater value to those metals, so that it may fairly be anticipated that the importance of the discovery will be duly appreciated. He proposes to subject copper, zinc, tin, and their compounds to an improved treatment, which facilitates their combination in proportions differing from any hitherto adopted, and in a manner to yield quite novel and superior results. For what may be designated his fundamental alloy he melts 12 lbs. of clean copper with 32 lbs. of old brass in a crucible in a brass-founder's melting-furnace, or in any other suitable furnace. When the metals are melted 2 ozs. of sodium chloride (common salt) or rock salt are added in a powdered state, and afterwards 4 lbs. of tin. The mixture is kept well stirred whilst 36 lbs. of clean zinc is gradually added to it, and the crucible is kept closed thereafter for about five minutes. There is then added an intimate mixture consisting of 1 oz. of potassium nitrate and  $\frac{1}{4}$  oz. of pearl ash, and afterwards an intimate mixture of  $\frac{1}{4}$  oz. of carbolic acid and  $\frac{1}{4}$  oz. of manganese; the mixture is then cooled, or partially cooled, and re-melted; there is next added an intimate mixture consisting of  $\frac{1}{4}$  oz. of ammonia and  $\frac{1}{4}$  oz. of tartar; the whole is then maintained steadily for a few minutes at a heat sufficient to keep it quite fluid without burning it, when it can be run into moulds. For compound No. 2, melt 32 lbs. clean copper, and add 2 ozs. of sodium chloride or rock salt, or 1 lb. of oyster or other marine shells. Keep well stirred, and add gradually 32 lbs. of clean zinc, and afterwards from 2 to 4 lbs. tin, according to hardness required; then add an intimate mixture of 1 oz. of potassium nitrate and  $\frac{1}{4}$  oz. of pearl ash. In five minutes afterwards add an intimate mixture of  $\frac{1}{4}$  oz. of ammonium carbonate and  $\frac{1}{4}$  oz. of carbolic acid, stir well, and cast or run into bars. For compound No. 3, melt 11 lbs. of clean copper with 4 lbs. of compound No. 1, and add gradually and whilst stirring 15 lbs. of clean zinc; afterwards add an intimate mixture of  $\frac{1}{4}$  oz. of potassium nitrate, and  $\frac{1}{4}$  oz. of manganese; stir for a few minutes and cast, re-melt, and add an intimate mixture of  $\frac{1}{4}$  oz. of potassium nitrate and  $\frac{1}{4}$  oz. of manganese, and afterwards add  $\frac{1}{4}$  oz. of tartaric acid. For compound No. 4, melt 26 lbs. of clean copper, and add gradually whilst stirring 20 lbs. of clean zinc; then add an intimate mixture of  $\frac{1}{4}$  oz. of potassium nitrate and  $\frac{1}{4}$  oz. of manganese; maintain in a liquid state for a few minutes, but without stirring, and keep stirred; add as a flux an intimate mixture of  $\frac{1}{4}$  oz. of borax and  $\frac{1}{4}$  oz. of tartar, and run into bars; after solidifying re-melt, and add gradually whilst stirring 6 lbs. of clean zinc, and then an intimate mixture of 1 oz. of potassium nitrate and 1 oz. of manganese, keep stirred for some minutes and cast. For compound No. 5, melt 24 lbs. of clean copper, and add gradually whilst stirring 18 lbs. of clean zinc; then add an intimate mixture of 2 ozs. of potassium nitrate and 2 ozs. of manganese, stir well, and cast. If wanted hard, re-melt after cooling, and add an intimate mixture of 1 oz. of carbolic acid and  $\frac{1}{4}$  oz. of ammonium carbonate, stir well and cast, using heliobore as a flux if necessary. For compound No. 6, melt 34 lbs. of clean copper with 4 lbs. of old brass, and gradually add whilst stirring  $\frac{3}{4}$  lb. of clean zinc; then add  $\frac{1}{4}$  oz. of blameth or its oxide, and afterwards  $\frac{3}{4}$  lb. of clean zinc, finishing with  $\frac{1}{4}$  oz. of tartaric acid.

Each of these compounds is capable of useful application to some distinct purpose; compounds 1, 2, and 3 may be run into water and re-percolated with advantage; compounds 4 and 5 make on excellent metal for heavy bushes and bearings when melted and mixed in equal proportions; compounds 2 and 4 make a useful intermediate metal when similarly treated; compounds 1, 2, and 3 make good bell metals when re-melted, with the addition of an intimate mixture of  $\frac{1}{4}$  oz. of potassium nitrate, and from  $\frac{1}{4}$  to  $\frac{1}{2}$  oz. of manganese, being fluxed if required by ammonium carbonate and borax or with heliobore and tartar. No. 1 may have 2 lbs. of clean copper added to it; Nos. 2 and 3 may be mixed in equal proportions. In making any of the compounds the zinc, or tin, and lead, may be melted separately, and be poured quickly into the crucible, instead of being put in in the solid state, and added gradually, as described. In cases where a certain amount of hardness or brittleness is wanted antimony or its oxide may be added to the extent of from 1 to 5 per centum of the total mixture. Oxide of manganese may be substituted for manganese in any of the compounds; similarly, soda salts may be substituted for the potash salts.

In certain circumstances the copper, zinc, tin, or their compounds may either be kept in a melted state throughout the entire process (excepting the final re-melting), or they may be subjected to repeated melting, conducting separate stages in the process; or the copper and old brass, or the zinc and tin, may be fused in separate crucibles, and treated with the chemicals suited for each of the different purposes they are to be used for. Instead of the crucible, air-furnaces having suitable openings to receive the different metals in a melted state, whereby they may be mixed together may be adopted. The said openings are also intended for introducing rods to stir the metals, as previously described. The fuel employed may be charcoal, coke, or other fuel ordinarily used for melting brass.

One way of carrying out the invention is to form a stock metal suitable without further treatment for some purposes, but which having been prepared with such a view may at any time be re-melted with any suitable metal or metals to form a particular alloy or compound. Compound No. 1, as already described, may be used as a stock metal, and on being re-melted from 5 to 100 per centum of copper may be added in a state of fusion in the second or compounding process. Or the said stock metal on being fused may be run into the copper, or the copper and stock metal may be melted together, or other metal or metals, such as old brass, gun-metal, or any compounds of like nature having similar properties. From 2 to 5 per centum of antimony may be introduced with or in place of the tin. The chemicals in all cases to be the same for any metals fused or run into the stock metal as No. 1, and in the same proportion of the new metals added, but in circumstances where the quality requires to be changed, such as to make metal for bushes, bells, and heavy bearings, the proportions of the ingredients must be varied in practice. But by way of example a compound extremely well suited amongst other things for bushes for high speed, bells, and such like is made in the following proportions:—copper 12 lbs., old brass or gun metal 32 lbs., spelter 32 lbs., tin  $\frac{1}{4}$  lb.; the old brass and copper to be melted together, and the spelter and tin to be fused and run into the crucible or furnace and properly stirred together. This being done 1 oz. of nitrate of potash and  $\frac{1}{4}$  oz. of carbolic acid in union are added, and on being well stirred  $\frac{1}{4}$  oz. of carbonate of soda and  $\frac{1}{4}$  oz. of manganese; he then runs the compound into bars or moulds for further use as a stock metal. This can be re-melted with fresh copper, making different qualities of metals in proportion to the amount of copper used, by adding 5 lbs. at a time up to 25 lbs., according to hardness or strength required; or the metals being fused the second time he adds 1 oz. of nitre and  $\frac{1}{4}$  oz. of pearl ash. But any other chemicals having the same or similar properties may be substituted. As a modification of this process he takes equal parts of old brass, gun-metal, or such like compounds, and of new copper, and fuses them together. On being melted he adds 1 per cent. of rock salt and of carbonate of potassium ground together, and next adds from 4 to 15 per cent. of new tin. Five minutes thereafter he adds ground together 1-16 per cent. of nitrate of potassium, and 1-16 per cent. of ammonia for every 5 per cent. of tin used. On being well stirred he adds in a melted state 50 per cent. of zinc or spelter, and stir 2-16 per cent. of a mixture of tartar and cream of tartar, together with 1 to 2-16 per cent. each of pearl ash and prussiate of potassium if hardness is wanted. Finally it must be maintained at a moderate heat for about ten minutes, taking care that it is not burned, being well stirred and skimmed. Nitrate of sodium, or strontium, or of barium may be substituted for the nitrate of potassium, and vice versa, in any of the preceding examples. Scrap tin and iron plate may be used instead of the tin as given in this example. In treating the copper that is to be used or melted with any of these alloys or compounds, he takes a convenient quantity of copper and puts it into an air-furnace with from 5 to 10 per cent. (by weight) of oxyd or other marine shell mixed in the ordinary way with the fuel in use for smelting purposes. When

the metal is thoroughly melted he adds 1-4 per cent. of carbonate of potash. After being stirred he taps it and casts it into bars or ingots, or it may be into an air-furnace or into crucibles where the alloy is already fused to form compound required. Or the copper thus prepared by alloying it with the potash metal (given as compound No. 1) forms a good bell-metal, and bells of different sounds can be produced of the same size, and out of the same metal by alloying with the prepared metal quantities ranging from 5 to 30 per cent. of the copper with 100 per cent. of the metal alloy or compound No. 1 by 5 lbs. a time according to tone required. Tartar, or cream of tartar, having 1-16 pearl ash may be used as a flux of about 1 to 2-16 per cent., or pearl ash or borax mixed up in sawdust wood may be substituted as a flux.

The gold and silver coloured alloys are described as being very close imitations of the more valuable metals, and it is anticipated that they will largely be used for the ornamentation of metal work; whilst with regard to bell metal alloys, it is considered that the facilities offered by having bell metal of uniform size for all the notes of a peal will immensely improve the quality of tone. We hope to be able at an early date to give details of the practical application of the invention.

#### MINING, METALS, AND MINERALS—PATENT MATTERS.

BY MICHAEL HENRY.

Patent Agent and Adviser, Memb. Soc. Arts, Assoc. Soc. Eng.

Mr. ALEXANDER WATKINS, of the Strand, has obtained a patent for apparatus for winding and setting watches and other timekeepers. The invention consists in the adaptation and application to watches and other timekeepers of a concentrated direct-action winder or winding apparatus, by means of which the watch may be wound without the application of a separate rate tube, such as a watch-key, placed over the ordinary square axis for the purpose. The winder or winding apparatus consists of a plain metal cylinder planted over the spring-box, barrel, or fuzee resting on the plate, but not touching thereto, the outside of which cylinder fits the dome of the case, and is intended to keep out dirt. Inside this cylinder is a circular or semi-circular outer suitably-formed plate, fixed to the ordinary square axis for winding, which plate is fixed, by pins or screw, another semicircular or other corresponding formed piece of metal, which is capable of being rotated on the axis of the said plate, and inside the above-named cylinder when out of use, or of being raised on the pins or pivots when required to be used for winding. The apparatus for setting the hands consists of a small metal cup applied to the centre axis of the hands, such metal cup being fluted or roughened on its outer surface, or cut into teeth, so as to give finger-hold to such surface, and admit of the hands being thereby turned as required.

Mr. J. GILCHRIST, of Glasgow has specified an invention for new or improved ratchet-brace, or ratchet drill-brace and grab combined. The invention consists of a ratchet-brace, or ratchet drill-brace and grab combined, having the actuating hand lever formed with a brace or double-kneed arm or crank. The head of one arm carries the ratchet and ratchet-spring with the drill-socket, all revolving loose within it in the same axial line, as the ratchet-spring, and inside the above-named cylinder when out of use, or of being raised on the pins or pivots when required to be used for winding. The apparatus for setting the hands consists of a small metal cup applied to the centre axis of the hands, such metal cup being fluted or roughened on its outer surface, or cut into teeth, so as to give finger-hold to such surface, and admit of the hands being thereby turned as required.

Mr. J. H. JOHNSON, of Lincoln's Inn-fields, has obtained a patent for an invention relating to locomotion, and means to be employed therein, communicated to him from abroad by Nicolas Joly, of Paris. The invention relates to improvements in locomotion, and in the roadway and rolling stock, both of which are specially adapted to one another. The roadway is constructed on the principle of an incomplete tube of rectangular section—that is to say, a rectangular tube, left open at one side, which tube may either be supported alone, or in combination with corresponding tubes situated parallel thereto (according to a single or double way is required), upon posts or pillars of wood, iron, or masonry, at such an elevation above the ground as to afford ready means for the passage of ordinary traffic beneath the same without the necessity of bridges, or it may be constructed upon the surface of the ground itself, in which latter case the usual provisions now adopted on ordinary railways would be required for the passage of ordinary traffic either over or under the line. Suitable guide-rails or surfaces, forming part of the improved roadway, serve to maintain the rolling stock in its upright position whilst travelling thereon, the main weight of the said rolling stock being supported upon two or more large bearings, or wheels, disposed in a single line with each other, somewhat after the fashion of a bicycle velocipede. In addition to the bearing wheels, which serve as guide-wheels, the carriage is provided with other and smaller wheels, which serve as guide-wheels against the guide-rails or surfaces on the roadway before referred to, and these guide-wheels are, moreover, so arranged as to be capable not only of maintaining the proper position of the carriage in its roadway, but also of acting when required as break-wheels for arresting or retarding the motion of the carriage, and in some cases as auxiliary propellers when ascending heavy gradients.

**BOILERS.**—The invention of Mr. E. CAMBRIDGE, Bristol, consists in adapting to the smoke-box of steam-boilers or generators a water-jacket, or clister, through which the feed water is supplied to the boiler, and is heated by the waste escaping from the fire-place or from the exhaust steam.

**DRYING PEAT.**—By the invention of Messrs. T. and W. A. ELLIS, Philadelphia, the interior of the casing on all four sides is lined with blocks of wood, cut diagonally or directly across the grain, so that the end grain or face of the wood may be presented to the interior of the mould or casing, and the suitable material, and in order to permit the said blocks to expand freely, they may be so fitted as to leave a vacant space at each corner of the casing.

**STEAM-ENGINES.**—Mr. A. BAUMANN, Heilbronn, by means of a slide-valve, actuated by two pistons of unequal area, working in special cylinders provided for that purpose, or by a piston-valve, which serves as a guide for the full steam pressure is admitted during one stroke of the engine, and the back stroke is effected by the expansion of the steam.

**PUMPS.**—The invention of Mr. B. H. JENKS, Philadelphia, consists in the employment, within a tube of suitable diameter and length, of a number of stationary feathered retaining wheels, alternating with rotary elevating wheels of corresponding form, but having their blades arranged at reverse angles to the stationary wheels. By this means water, sand, mud, and other liquid or semi-fluid substances can be raised or pumped to any desired height by a constant application of power to the ascending column.

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